Correlation between *Lonicera maackii* abundance and elevation

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Introduction

Lonicera maackii (Rupr,), or Amur honeysuckle, is an invasive plant in the Caprifoliaceace family. Introduced around 1896 from Asia as an ornamental plant, it escaped cultivation and has invaded 24 states in the eastern United States. Young shrubs are characterized by rapid height growth and high stem recruitment (Fighting 2002). It is a large, upright, deciduous shrub with multiple stems from a basal growth. A plethora of paired white flowers in the spring are a source of pollen for bees (Trisel 1997). Red berries, ripening in October, are consumed by a number of animals, however the seeds are not a preferred food and most remain uneaten (Williams et al., 1992 and Triesel 1997). Seed dispersal by birds is a likely source for the widespread colonization by *L. maackii*.

This plant now dominates the understory of the bottomland hardwood forest at the Olentangy River Wetland Research Park. The objective of this research project was to evaluate the extent of *L. maackii* growth and compare its density in low (wet) and high (dry) elevation plots in order to determine an effective restoration strategy.

Background

Amur honeysuckle has become a major problem in many eastern ecosystems, often having a negative impact on native tree seedlings and herbs (Gould 1996; Collier 1997; Hutchinson and Vankat 1997; and Trisel 1997). It invades habitats with high light availability then opportunistically radiates to forest interiors. Often becoming the most abundant shrub in many forests, *L. maackii* is able to out-compete native species through a host of various life history traits such as high seed production, seed longevity, interference ability and rapid growth (Trisel 1997 and Baker 1974), long-range seed dispersal, rapid response to resource availability, high photosynthesis rates, and early reproductive maturity (Bazzaz 1974 and Trisel 1997). Additionally, the dense growth of the Amur honeysuckle prohibits the growth of native seedlings and herbaceous plants beneath primarily by leafing earlier in the spring and lasting longer in the fall than most endemic species (Trisel and Gorchov 1994). Its extensive shallow roots reduce nutrient availability for other plants (Amur 2002). With the absence of competitors, honeysuckle has taken over many ecosystems, decreasing the diversity and richness of native species assemblages.

The potential benefits of honeysuckle elimination to conservation efforts are extensive. Initially, with the allocation of resources no longer being dominated by the invasive plant, native species will be able to receive further nutrients. Also, the dense leaf canopy of honeysuckle will be gone allowing sunlight to reach the forest floor. Due to these factors, the species richness and diversity in the area are likely to increase. Higher species diversity leads to augmented resilience, or the ability of ecosystems to recover from disturbances (Molles 2002). However, it is unknown which habitats within the ecosystem at which the honeysuckle flourishes. The densities of honeysuckle are much lower in some areas than in others, therefore it is important to determine why. One hypothesis investigated in this study is elevation. We predict that at lower elevations, honeysuckle is unable to survive due to the hydrology.

Methods

This study was conducted at the Olentangy River Wetland Research Park in the bottomland hardwood forest located between the Olentangy River and adjacent wetlands (Figure 1). Data collection was restricted to the section of forest that was not cleared of *L. maackii;* the box on the diagram indicates the study area. From 30 pre-existing plots used for a previous research project, 17 plots, 9 "upland" and 8 "lowland," were chosen. As described in Musson and Mitsch (2003), elevations below 727 ft were delineated as lowland, while those above were designated upland. The elevation at river level was obtained from an on-site gauge and the difference in elevation from the river to the selected plots was determined with a laser transit. From this data, the actual elevations of all the plots were calculated. An assumption for this method is that lowlands are more frequently flooded than are uplands.

To estimate the abundance of *L. maackii* at each location, one member of the research team stood at the center of the plot and held a 1.78 m string while another member kept the string taut and walked around the other in a circular fashion. All *L. maackii* plants within reach of the string were counted and recorded in one of the 2 height categories (above or below 20-inches tall), giving the number of *L. maackii* individuals per 10 m^2.

T-tests were conducted to evaluate if *L. maackii* exhibits a preference for lowland or upland microhabitats.

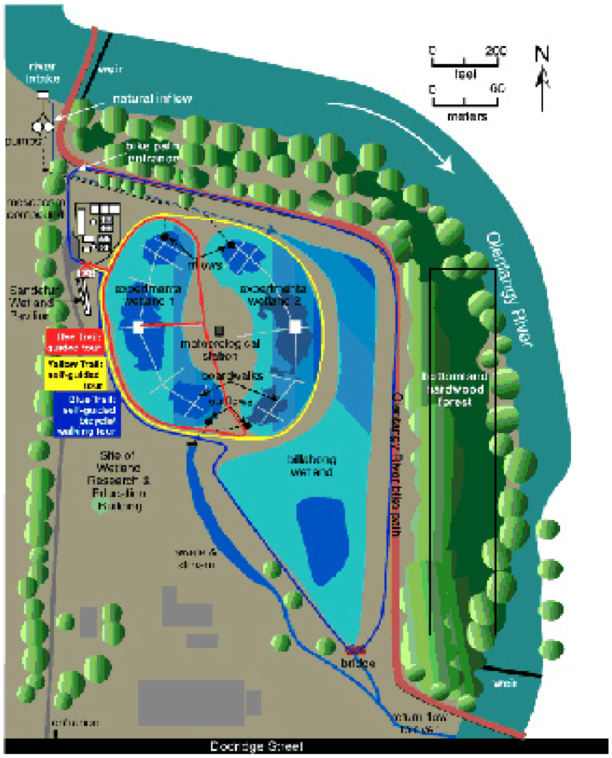

Figure 1: The Olentangy River Wetland Research Park with study site in the bottomland hardwood forest indicated in the box

Results

Table 1 displays the elevations and honeysuckle densities of the sample plots. Results of the experiment reveal a weak positive correlation between elevation and honeysuckle abundance (r=0.5132) (Figure 2). As elevation rises, there is a general trend of an increase in *Lonicera maackii* abundance ($y = 0.5267x^2 - 764.13x + 277148$). An average of all upland was 20 *Lonicera* individuals per plot, while the average was 3.0 for lowlands (Figure 3). A t-test revealed this to be a significant difference (Table 2).

Discussion

Hydrology is an important factor for the life cycle of many plants, including *Lonicera maackii*. It is most likely due to this hydrology that *L. maackii* is less abundant in the lower elevations. While the life history characteristics of the plant allow it to dominate in many ecosystems, the hydrology of the low elevations selects against the plant. Some woody plants such as *Populus deltoides* are adapted for lowlands and these plants can handle anaerobic conditions of soil. However, as this study shows, honeysuckle abundance increases with elevation. Drier soils are important for honeysuckle establishment as well as rapid growth. The four breeches cut into the artificial levee along the Olentangy River changed the hydrology of the area, potentially allowing trees such as *Populus deltoides* to dominate over plants such as L.*maackii*.

The information gathered by this study could help in establishing methods for managing the invasive shrub. Continued restoration of the bottomland hardwood forest to its original hydrologic conditions should be further investigated as an alternative, longer-term method to decrease the abundance of the Amur honeysuckle. Resources spent on herbicide and mechanical removal could be instead directed towards other projects as restoration of the natural hydrology would help control honeysuckle without continued harvesting and chemical spraying. Further studies analyzing soil texture and moisture content could further define other variables besides hydrology that are important for honeysuckle control.

Table 1. Sample plots and the corresponding elevations and honeysuckle plant densities.

Plot number	Plot elevation (ft above sea level)	Honeysuckle density (per $10m^2$)
7	724.7	0
11	724.71	7
14	724.76	16
16	725.56	2
9	726.18	2
15	726.41	1
18	726.63	2
17	726.68	0
8	726.69	0
31	727.99	15
20	728.47	15
19	728.51	1
30	729.07	12
21	731.03	39
29	731.06	27
22	731.56	16
23	731.97	16

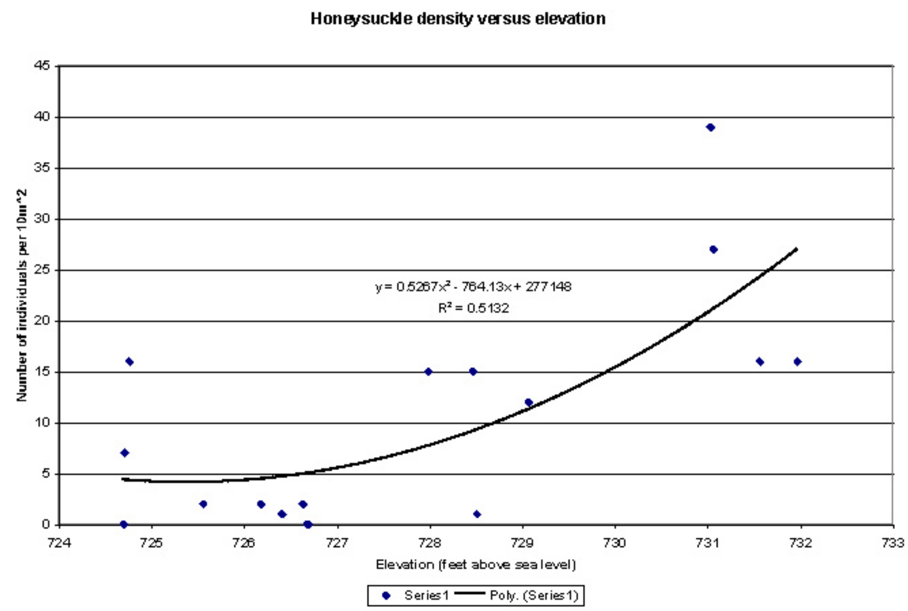

Figure 2. Correlation between honeysuckle abundance and elevation.

Table 2. Summary of t-tests preformed to determine whether elevation had significant effect on honeysuckle abundance.

Plot Locations	Tcalc	Tcrit @P=0.05	Significant?**Y/N**
Upland v. lowland	7.58	2.13	Y
Up <knee high v. Low <knee high	4.06	2.13	Y
Up > knee high v. low > knee high	3.71	2.13	Y

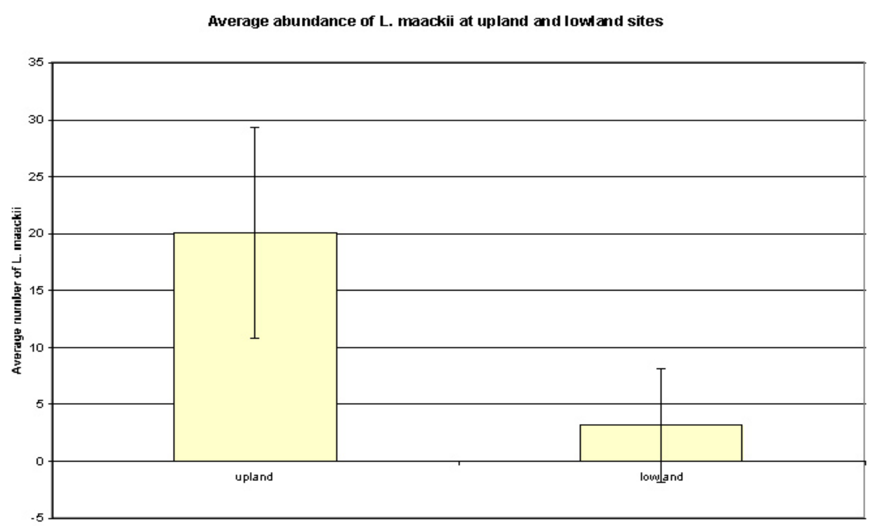

Figure 3. Average abundance of Amur honeysuckle at upland and lowland sites.

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